CENWS-OD-TS-DM

MEMORANDUM FOR RECORD **14 April 2005**

SUBJECT: DETERMINATION OF THE SUITABILITY ON PROPSED DREDGED MATERIAL CHARACTERIZED FROM THE PORT OF SEATTLE FISHERMEN'S TERMINAL (2005-00421) AS EVALUATED UNDER SECTION 404 OF THE CLEAN WATER ACT FOR UNCONFINED-OPEN-WATER DISPOSAL.

1. The following summary reflects the consensus determination of the Agencies that comprise the regional Dredged Material Management Program (DMMP) for the State of Washington. The agencies include the Corps of Engineers, Department of Ecology, Department of Natural Resources, and the Environmental Protection Agency. The agencies were charged with determining the suitability of 47,793 cy of proposed dredged material from the Fishermen's Terminal dredging project (**Area 1 = 32,709 cy; Area 2 = 15,084 cy**) to restore navigation depths within the terminal for the North Pacific fishing fleet. The Fishermen's Terminal is currently undergoing major reconstruction and upgrades, to increase fairway widths, more side-tie moorage and longer slips, and higher voltage/amperage services to better match the projected demand from the commercial fishing fleet. The suitable dredged material is proposed for disposal at the Elliott Bay open-water non-dispersive site.

2. The project was ranked high (Salmon Bay) for testing purposes, and the two proposed dredging subareas (Area 1 and Area 2) were sampled on September 28-30, 2004, by vibracorer. Two vibracore samples were collected and composited within each of the 8-DMMUs in Area 1 and 4-DMMUs within Area 2 (**Figures 1 and 2**). After chemical testing was completed, the Port of Seattle elected to withdraw Area 2 from further consideration due to changing priorities.

3. Relevant dates for regulatory tracking purposes are included in **Table 1**.

Table 1. Regulatory Tracking Information and Dates

Corps Permit Application #:	2005-00421
Initial SAP submittal date:	September 3, 2004
SAP approval letter date:	September 21, 2004
Sampling date(s):	September 28-30, 2004
Sediment data characterization report submittal date:	February 5, 2005
DAIS Tracking Number:	FSHTM-1-B-F-206
Recency Determination Date: High (2 years)	September 2006

4. The Sampling and Analysis Plan was approved by the Agencies on September 21, 2004. SAP was followed as approved, and quality assurance/quality control

guidelines specified by the PSDDA Users Manual were generally complied with. The applicant's contractor provided additional information on bioassay testing concerns in freshwater sediments as a response to the DMMP SAP comment/approval letter (Attachment 1). The DMMP agencies subsequently agreed to compare porewater TBT results from acclimated sediments to the SL and BT (0.15 ug/L) for determining need for subsequent bioaccumulation testing requirements. This decision was based on the rationale presented in the applicant's November 22, 2004 letter to the DMMP agencies (**Attachment 2**), and the DMMP's December 6, 2004 response letter (**Attachment 3**). The data gathered were deemed sufficient and acceptable for decision-making by the DMMP agencies based on best professional judgment.

5. **Table 2** provides a summary of the results from the conventional and chemical analyses for the twelve DMMUs collected within Area 1 and Area 2 compared to DMMP and SMS chemical guidelines. Chemical analysis results for these twelve DMMUs indicated that there were seven detected exceedances of the DMMP SL guideline for **mercury**, two exceedances each of the SLs for **lead** and **zinc** and four detected exceedances of the SL for **Total PCBs**. In addition, there were seven exceedances of the porewater SL for **TBT** in the unacclimated samples but only two exceedances of the porewater SL for **TBT** in acclimated samples(**Table 3**). Full chemistry testing results are provided in Table 4.

6. Comparison to SMS standards (**Table 2**) indicated that there was one exceedance of the SQS (only) and six exceedances of the CSL for **mercury**, along with one exceedance each of the SQS and CSL for **lead**. There were also two exceedances of the SQS for **zinc** and one exceedance of the SQS for Total **PCB**s. Finally, there were nine exceedances of the recommended no effects level for porewater **TBT** (0.05 ug/L) in unacclimated samples, but only six exceedances of this value for acclimated samples.

7. **<u>Biological Testing Summary</u>**. The agencies agreed to allow the applicants to acclimate the test samples to the saline conditions required by toxicity test protocols until such time as any accumulated ammonia had declined to stable and acceptable levels, prior to biological testing (see Attachment 1, response to comment 3). The acclimation showed that full acclimation occurred by day 31 with a dramatic decrease in ammonia concentrations. Biological testing commenced after acclimating for 31 days. **Table 5a** provides the bioassay interpretation/performance requirements for the three PSDDA bioassays. Table 5b provides a comparison of test performance for a subset of acclimated and unacclimated sediments. **Tables 6** (*Eohaustorius*, amphipod survival), **Table 7** (*Mytilus* bivalve larval development), **Table 8** (*Neanthes* 20-day growth), and **Table 9** (testing interpretation summary) provides the testing summary for the Area 1 sediment bioassays for the amphipod and *Neanthes* test[1]. **Table 10** provides an alternative DMMP interpretation of the larval data based

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[1] Note that the bivalve larval interpretation summary provided in **Table 9**, as an alternative approach recommended by the applicant's contractors (Anchor Environmental/Weston Solutions) to use Test Sediment 8CS as a surrogate reference for interpreting these results (Attachment 4), was rejected by the DMMP. The DMMP provided an alternative conservative interpretation approach summarized in **Table 10**.

on best-professional-judgment for the bivalve larval bioassay results, given reference performance problems, that is discussed in detail in **paragraph 12**. Biological testing was only performed on the Area 1 DMMUs except DMMU-A5, which had no SL exceedances. Of the two Lake Washington freshwater reference sediments selected, FT-Ref-1 and FT-Ref-2, FT-Ref-1 was rejected because of low pH (less than 4).

8. **Sediment Acclimation.** The sediment acclimation procedure followed (for ammonia and TBT) was effective in adjusting the porewater salinity and establishing a marine microbial community that could process ammonia (**Attachment 1**). The porewater salinity reached equilibrium within six days of the introduction of seawater and was effectively adjusted by the addition of brine to the overlying water. The results showed a significant drop in TBT concentrations in acclimated sediments (**Attachment 2**). From the Data Summary Report: "There was an initial increase in ammonia concentrations both in porewater and overlying water following introduction of marine waters to freshwater sediments. After day 6, porewater ammonia concentrations began to decrease gradually, and after day 21, ammonia concentrations in overlying water began to decrease." The bivalve larval tests were initiated on day 41 following acclimation. When acclimated and unacclimated bioassay treatments were compared, there were significant differences in *Neanthes* mean individual growth (MIG) and bivalve larval development. *Neanthes* MIG and larval combined survival were significantly lower in the unacclimated FF-Ref-2 and A1-8CS treatments, relative to the acclimated treatments. With the exception of treatment A1-2CS, MIG in the *Neanthes* test was approximately 0.2 mg/ind/day greater in the acclimated sediment treatments than in the unacclimated treatments. Larval combined mortality was 87 percent to 100 percent in the unacclimated sediments and would have been evaluated as 1-hit failures for each of these treatments (**Table 5b**). However, amphipod survival was not significantly different for the three acclimated and unacclimated test sediment treatments from Fishermen's Terminal (**Table 5b**).

9. Water quality monitoring consisted of temperature, dissolved oxygen, salinity, and pH measurements daily in overlying water. Dissolved oxygen remained within acceptable limits throughout the test. The mean mortality in the control sediment for the amphipod toxicity test was 5 percent, meeting the PSEP 1995 test performance standard of less than or equal to 10 percent. The LC50 for the cadmium reference toxicant test was 6.8 mg Cd/L, which is within the control chart limits (2.76 to 7.6 mg/Cd/L), indicating that the test organisms sensitivity were similar to those previously tested at the MEC laboratory.

10. **Reference Sediment performance problems and bivalve larval interpretation.** For the bivalve larval test, the mean percent normal survivorship in reference treatment FT-Ref-2 was 25.4 percent, indicating that this reference sediment did not meet the performance requirement as a suitable test sediment comparison. In the test sediment treatments, mean normal survival ranged from 76.2 percent in A1-8CS to 7.8 percent in A1-2CS. Searching for a way to evaluate the test sediment results, otherwise valid for decision making except for lack of a suitable reference sediment (given the poor performance of the FT-Ref-2 sediment), the applicant consulted with

the laboratory practitioners and recommended using the A1-8CS test sediment as a surrogate reference sediment to evaluate the test sediment results. This test sediment met the minimum performance requirements for a reference sediment relative to control (**Attachment 4**). The chemical testing results for A1-8CS indicated that this DMMU had **lead** concentrations slightly over the SL, quantitated at 482 mg/kg, but no other SL exceedances. TBT was present in unacclimated sediments, but dropped below the PSDDA SL in the acclimated sediments. A marine reference sediment was not deemed to be the appropriate reference for comparison because the tested sediments were freshwater sediments.

11. After much consideration, the DMMP agencies chose to reject this recommendation and use an alternative approach (described below). The agencies have never used this proposed interpretive approach - a within-site test sediment is simply not an appropriate point of comparison for test sediment toxicity results.

12. The DMMP agencies first elected to use 80% absolute as a nominal rate of normal development for a freshwater reference sediment to interpret the bivalve larval results. The summary of this interpretation provided in **Table 10** indicates that normal survivorship would be significantly lower in test sediments A1-1CS, A1-2CS, A1-3CS, A1-4CS, A1-6CS, and A1-7CS. There would be 1-hit responses for A1-1CS, and A1-2CS, and A1-7CS, with 2-hit responses for A1-3CS, A1-4CS and A1-6CS using a weight of evidence approach and best-professional judgment. Two-hit responses were not corroborated by the other two bioassays, and therefore DMMU's A1-3CS, A1-4CS and A1-6CS would pass the non-dispersive site guidelines, whereas A1-1CS, A1-2CS and A1-7CS would fail the non-dispersive site guidelines using BPJ (**Table 2**). However, after further discussion and based on what DMMP staff believed to be typical normal development for past marine reference samples, the agencies decided that it would be relatively unlikely for a freshwater reference sample to exhibit normal development > 85% of that observed in the negative control. With this assumption, if the nominal reference sample for this project was observed to have 85% normal survival relative to the negative control, then A1-7CS (57.4% relative to control) would fail only the two-hit interpretive guideline (< 30% difference). Lacking a second toxicity test 2-hit failure, this sample would then pass.

13. The results of the chemical and biological analyses indicate that within Area 1, 8,559 cy of proposed dredged material represented by DMMU's A1-1CS and A1-2CS are unsuitable for unconfined open-water disposal, whereas 24,150 cy of material represented by DMMUs A1-3CS, A1-4CS, A1-5CS, A1-6CS, A1-7CS and A1-8CS, are deemed suitable for unconfined open-water disposal at the Elliott Bay disposal site. The 15,084 cy of material from Area 2 was withdrawn from active consideration for dredging due to changing priorities of the Port of Seattle. Testing was incomplete for 3 of 4 DMMU's within Area 2 (A2A-1CS, A2B-2CS, A2B-3CS) and these DMMUs are determined to be unsuitable for unconfined-open water pending completion of the required biological testing, including bioaccumulation.

14. This memorandum documents the suitability of material proposed for dredging from Area 1 of the Fishermen's Terminal for unconfined open-water disposal at the Elliott Bay disposal site. However, this suitability determination does not constitute final agency approval of the project. A dredging plan for this project must be completed as part of the final project approval process. A final decision will be made after full consideration of agency input, and after an alternatives analysis is done under Section 404(b)(1) of the Clean Water Act.

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Concur:

14 April 05 [signature]
Date David Kendall, Ph.D., Seattle District Corps of Engineers

14, APRIL 2005 [signature]
Date Tom Gries/Cinde Donoghue, Washington Department of Ecology

14 April 2005 [signature] [signature]
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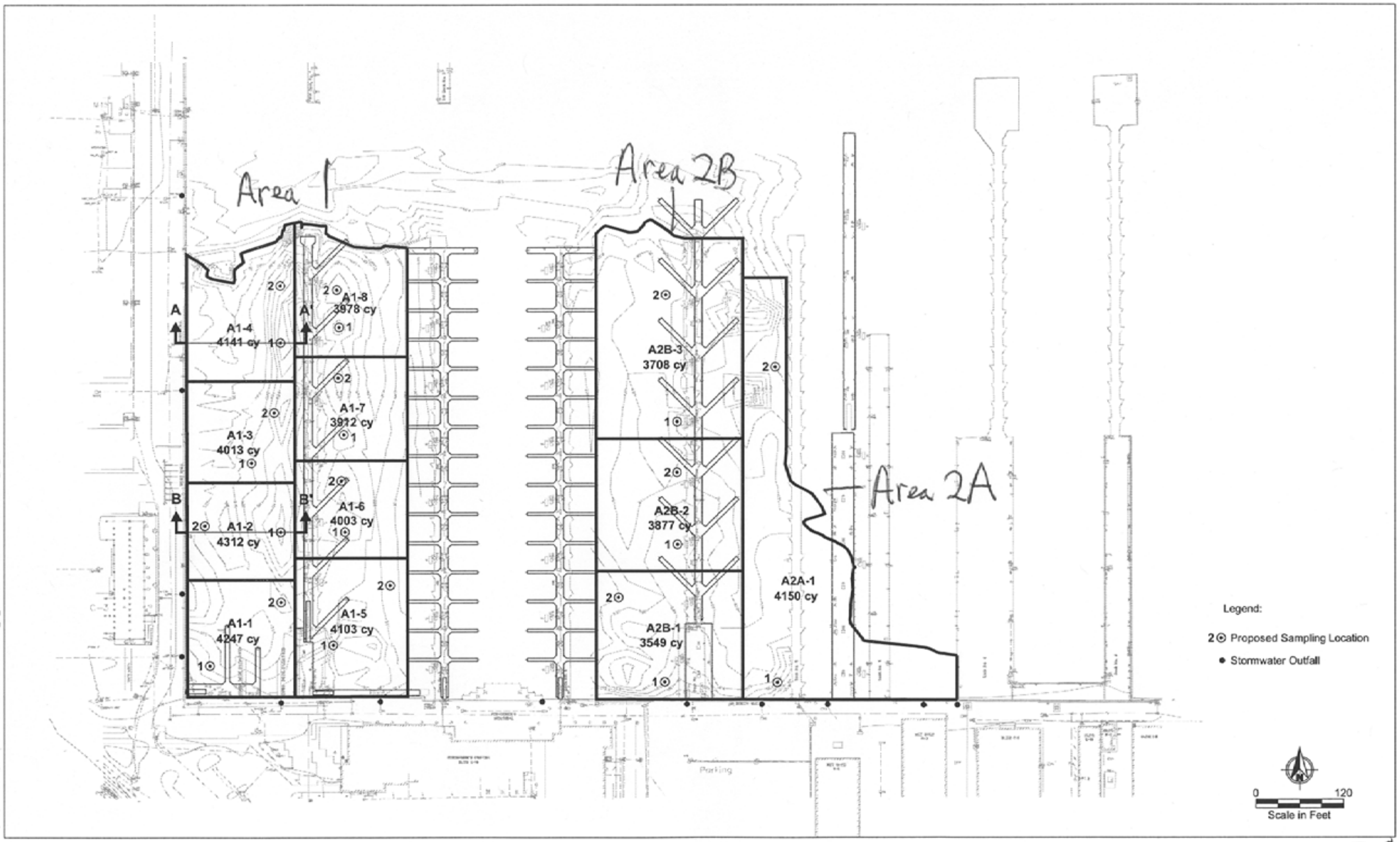
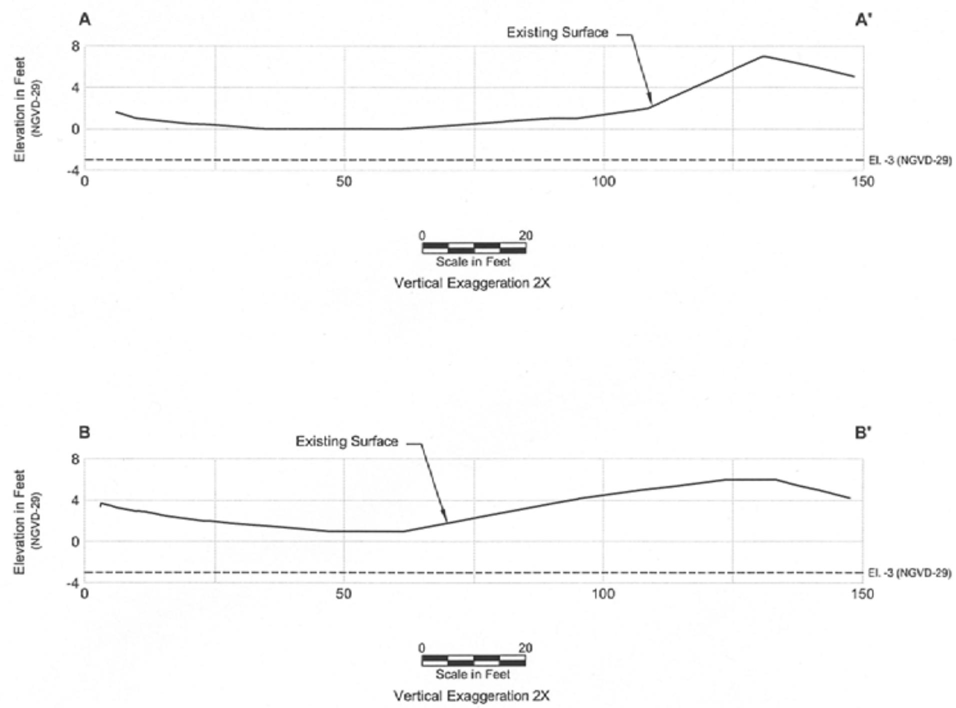
DMMO File



ANCHOR ENVIRONMENTAL, L.L.C.

Figure 1. Delineation of DMMUS and Proposed Sampling Locations
Fishermen's Terminal Sediment Characterization

Sep 21, 2004 4:04pm dholmer K:\Jobs\040003-Port_of_Seattle\04000301\04000301-08.dwg Fig 4



ANCHOR ENVIRONMENTAL, L.L.C.

Figure 2.

Figure
Cross Sections
Fishermen's Terminal Sediment Characterization

Table 2. DMMP Sediment Testing Summary and Evaluation for Fishermen's Terminal Dredging Footprint

								Area 1 Material																				
							DMMU I	DMMU-A1-1C			DMMU-A1-2C			DMMU-A1-3CS			DMMU-A1-4CS			DMMU-A1-5CS			DMMU-A1-6			DMMU-A1-7CS		
	DMMP				SMS			dry wgt	TOC-norm	VQ	dry wgt	TOC-norm	VQ	dry wgt	TOC-norm	VQ	dry wgt	TOC-norm	VQ	dry wgt	TOC-norm	VQ	dry wgt	TOC-norm	VQ	dry wgt	TOC-norm	VQ
CHEMICAL NAME	Units	SL	BT	ML	Unita	SQS	CSL	DMMP	SMS		DMMP	SMS		DMMP	SMS		DMMP	SMS		DMMP	SMS		DMMP	SMS		DMMP	SMS	
Lead	mg/kg	450	975	###	mg/kg	450	530																					
Mercury	mg/kg	0.41	1.5	2.3	mg/kg	0.41	0.59				0.86	0.86					0.76	0.76					0.67	0.67		0.45	0.45	
Zinc	mg/kg	410	###	###	mg/kg	410	960																					
Total PCBs	mg/kg	0.13	38*	3.1	mg/kg	12	65	140	1.85	J	659	5.73		470	13.5		215	3.85										
TBT- (ion) Unacclimated	ug/L	0.15	0.15	--	ug/L	(0.05)*	(0.35)*	0.16	0.16		0.18	0.18		0.11	0.11		0.06	0.06		0.04	0.04		0.31	0.31		0.31	0.31	
TBT (ion) Acclimated	ug/L	0.15	0.15	--	ug/L	(0.05)*	(0.35)*	0.08	0.08		0.12	0.12		--	--		--	--		--	--		0.07	0.07		0.04	0.04	
Total Solids	%							54.3			43.0			43.4			39.7			23.0			36.6			22.0		
Total Volatile Solids	%							12.0			17.4			8.2			10.9			29.0			21.5			15.4		
Total Organic Carbon	%							7.6			11.5			3.5			5.6			12.1			8.55			7.7		
Total Ammonia	mg/kg							87.1			####			73.2			144.0			96.1			93.4			106.0		
Total Sulfides	mg/kg							1.8 u			29			80			60.0			37.0			7.5			74		
Gravel	%							0.8			2.4			2.5			9.1			2.8			4.2			3.7		
Sand	%							59.3			57.3			32.3			39.5			29.7			22.6			34.3		
Silt	%							22.6			22.3			42.7			33.1			44.8			44.3			37.0		
Clay	%							17.2			18.0			22.4			16.2			22.7			28.9			25.1		
Fines (percent silt + clay)	%							39.8			40.3			65.1			51.3			67.5			73.2			62.1		
Eohaustorius estuarius hits:								NH			NH			NH			NH						NH			NH		
Mytilus galloprovincialis hits:								1H			1H			2H			2H						2H			2H (bpj)		
Neanthes arenaceodentata hits:								NH			NH			NH			NH						NH			NH		
Bioassay Determination: (P/F)								FAIL			FAIL			PASS			PASS			NT			PASS			PASS		
BTs exceeded:								no			no			no			no			no			no			no		
Bioaccumulation conducted:																												
Bioaccumulation Determination:																												
ML Rule exceeded:								no			no			no			no			no			no			no		
PSDDA Determination:								FAIL			FAIL			PASS			PASS			PASS			PASS			PASS		
DMMU Volume:	cy							####			####			4,013			4,141			4,103			4,003			3,912		
Rank								H			H			H			H			H			H			H		
Mean Core sampling depth	ft							2.7			3.9			2.4			4.5			1.0			2.5			3.0		
Maximum sampling depth (mudline)								3.1			6.2			3.3			7.1			1.8			2.8			3.3		
DMMU ID:								DMMU-A1-1C			DMMU-A1-2C			DMMU-A1-3CS			DMMU-A1-4CS			DMMU-A1-5CS			DMMU-A1-6			DMMU-A1-7CS		

Legend:

*** reason-to-believe adverse effect levels noted in literature**

SL = Screening Level exceedance

BT = Bioaccumulation Trigger exceedance

ML = Maximum Level exceedance

BT/ML = BT/ML exceedance

2H = Two Hit Bioassay Response (nondispersive)

1H = One Hit Bioassay Response (nondispersive)

P = Pass (Suitable for UCOWD)

F = Failure (UCOWD Unsuitable)

SQS = Sediment Quality Standards exceedance (SMS)

CSL = Cleanup Screening Level exceedance (SMS)

VQ = Validation Qualifier

UCOWD = Unconfined open-water disposal

NH = No Hit

NT = No Test

bpj = best professional judgement

F (BTI) = Failure (biological testing incomplete)

Area 1 Material:			
Failed .	**8,559**	**cy**	26.2%
Pass	**24,150**	**cy**	73.8%
	32,709	**cy**	**TOTAL**

Area 2 Material (withdrawn from DMMP consideration)

15,084 cy

47,793 cy total volume

Table 2. DMMP Sediment Testing Summary and Evaluation for Fishermen's Terminal Dredging Footprint

											Area 2 Material												Reference Samples					
							DMMU ID	DMMU-A1-8CS			DMMU-A2A-1CS			DMMU-A2B-1CS			DMMU-A2B-2CS			DMMU-A2B-3CS			FT-REF-1			FT-REF-2		
	DMMP				SMS			dry wgt	TOC-norm	VQ	dry wgt	TOC-norm	VQ	dry wgt	TOC-norm	VQ	dry wgt	TOC-norm	VQ	dry wgt	TOC-norm	VQ	dry wgt	TOC-norm	VQ	dry wgt	TOC-norm	VQ
CHEMICAL NAME	Units	SL	BT	ML	Unita	SQS	CSL	DMMP	SMS		DMMP	SMS		DMMP	SMS		DMMP	SMS		DMMP	SMS		DMMP	SMS		DMMP	SMS	
Lead	mg/kg	450	975	###	mg/kg	450	530	482	482											1,860	1,860							
Mercury	mg/kg	0.41	1.5	2.3	mg/kg	0.41	0.59				11	11					0.66	0.66		2.12	2.12							
Zinc	mg/kg	410	###	###	mg/kg	410	960				427	427								609	609							
Total PCBs	mg/kg	0.13	38*	3.1	mg/kg	12	65																					
TBT- (ion) Unacclimated	ug/L	0.15	0.15	--	ug/L	(0.05)*	(0.35)*	1.1	1.1		12	12		0.022	0.02	U	4.5	4.5		0.029	0.029		###	0.025	U	###	0.025	U
TBT (ion) Acclimated	ug/L	0.15	0.15	--	ug/L	(0.05)*	(0.35)*	0.12	0.12		0.82	0.82		--	--		0.24	0.24		--	--		--	--		--	--	
Total Solids	%							45.8			38.8			13.9			40.6			27.1			29.8			37.5		
Total Volatile Solids	%							6.5			10.4			54.4			7.5			12.6			12.8			17.8		
Total Organic Carbon	%							2.3			4.4			20.5			2.8			6.5			4.7			5.7		
Total Ammonia	mg/kg							98.5			88.1			145.0			71.9			143.0			###			38.3		
Total Sulfides	mg/kg							140			230			46.0			46			19			130			###		
Gravel	%							0.7			2.5			2.6			1.5			1.7			0.0			7.1		
Sand	%							16.8			18.2			37.0			6.5			13.9			20.6			40.4		
Silt	%							46.5			49.7			33.1			51.8			57.8			65.9			32.1		
Clay	%							35.9			29.7			27.3			40.1			26.7			13.5			20.3		
Fines (percent silt + clay)	%							82.4			79.4			60.4			91.9			84.5			79.4			52.4		
Eohaustorius estuarius hits:								NH																				
Mytilus galloprovincialis hits:								NH																				
Neanthes arenaceodentata hits:								NH																				
Bioassay Determination: (P/F)								PASS																				
BTs exceeded:								no			yes			no			yes			yes								
Bioaccumulation conducted:																												
Bioaccumulation Determination:																												
ML Rule exceeded:								no			yes			no			no			yes								
PSDDA Determination:								PASS			F (BTI)			PASS			F (BTI)			F (BTI)								
DMMU Volume:	cy							3,978			4,150			3,549			3,677			3,708								
Rank								H			H			H			H			H								
Mean Core sampling depth	ft							2.3			1.8			0.7			1.1			0.6								
Maximum sampling depth (mudline)								2.6			1.9			0.8			1.3			0.6								
DMMU ID:								DMMU-A1-8CS			DMMU-A2A-1CS			DMMU-A2B-1CS			DMMU-A2B-2CS			DMMU-A2B-3CS			FT-REF-1			FT-REF-2		

Legend:

*** reason-to-believe adverse effect levels noted in literature**

SL = Screening Level exceedance

BT = Bioaccumulation Trigger exceedance

ML = Maximum Level exceedance

BT/ML = BT/ML exceedance

2H = Two Hit Bioassay Response (nondispersive)

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bpj = best professional judgement

F (BTI) = Failure (biological testing incomplete)

Table 3
TBT Concentrations in Acclimated and Unacclimated Sediments

		DMMP Screening Level and BioTrigger = 0.15 µg/L Tributyltin (µg/L as tin ion)		
Location ID	**Sample ID**	**Sample Date**	**TBT–Unacclimated**	**TBT–Acclimated**
A1-1	A1-1-CS	9/28/2004	**0.16**	0.079
A1-2	A1-2CS	9/29/2004	**0.18**	0.12
A1-3	A1-3CS	9/29/2004	0.11	--
A1-4	A1-4CS	9/29/2004	0.063	--
A1-5	A1-5CS	9/29/2004	0.042	--
A1-6	A1-6CS	9/29/2004	**0.31**	0.065
A1-7	A1-7CS	9/29/2004	**0.31**	0.036
A1-8	A1-8CS	9/30/2004	**1.1**	0.12
A2A-1	A2A-1CS	9/30/2004	**12**	**0.82**
A2B-1	A2B-1-CS	9/28/2004	0.022 U	--
A2B-2	A2B-2CS	9/30/2004	**4.5**	**0.24**
A2B-3	A2B-3CS	9/30/2004	0.029	--
FT-REF-1	FT-REF-1	10/14/2004	0.025 U	--
FT-REF-2	FT-REF-2	10/14/2004	0.025 U	--

Notes:
All samples exceeding the PSDDA Screening Levels were acclimated for at least 31 days in marine waters and then reanalyzed.
[12] The result is higher than the DMMP Bioaccumulation Trigger (BT).

Table [illegible]

Summary of Analytical Results for the DMMP Analyte List* and Comparison with the Evaluation Criteria

Location ID Sample ID Sample Date Depth Interval	DMMP Evaluation Criteria SL	 BT	 ML	A1-1 A1-1-CS 9/28/2004 0-7.5 ft	A1-2 A1-2CS 9/29/2004 0-7.3 ft	A1-3 A1-3CS 9/29/2004 0-5.8 ft	A1-4 A1-4CS 9/29/2004 0-6.5 ft	A1-5 A1-5CS 9/29/2004 0-5.5 ft	A1-6 A1-6CS 9/29/2004 0-4.7 ft	A1-7 A1-7CS 9/29/2004 0-6.4 ft	A1-8 A1-8CS 9/30/2004 0-7.7 ft	A2A-1 A2A-1CS 9/30/2004 0-3.6 ft	A2B-1 A2B-1-CS 9/28/2004 0-5.6 ft	A2B-2 A2B-2CS 9/30/2004 0-4.9 ft	A2B-3 A2B-3CS 9/30/2004 0-5.4 ft	FT-REF-1 FT-REF-1 10/14/2004 0-25 cm	FT-REF-2 FT-REF-2 10/14/2004 0-25 cm
Conventionals (%)																	
Ammonia (mg/kg)	--	--	--	87.1	162	73.2	144	96.1	93.4	106	98.5	88.1	145	71.9	143	138	38.3
Sulfide (mg/kg)	--	--	--	1.8 U	29	80	60	37	7.5	74	140	230	46	46	19	130	130
Total Organic Carbon	--	--	--	7.57	11.5	3.48	5.58	12.1	8.55	7.71	2.28	4.38	20.5	2.78	6.52	4.71	5.72
Total solids	--	--	--	46.5	35.6	48.6	43.5	25.9	29.9	32.7	47	37.1	16.2	37.2	26.8	31.1	22.8
Preserved Total Solids	--	--	--	54.3	43	43.4	39.7	23	36.6	22	45.8	38.8	13.9	40.6	27.1	29.8	37.5
Total Volatile Solids	--	--	--	12	17.4	8.16	10.9	29	21.5	15.4	6.52	10.4	54.4	7.5	12.6	12.8	17.8
Grain Size (%)																	
Gravel	--	--	--	0.8	2.4	2.5	9.1	2.8	4.2	3.7	0.7	2.5	2.6	1.5	1.7	0.01	7.1
Sand	--	--	--	59.3	57.3	32.3	39.5	29.7	22.6	34.3	16.8	18.2	37	6.5	13.9	20.6	40.4
Silt	--	--	--	22.6	22.3	42.7	33.1	44.8	44.3	37	46.5	49.7	33.1	51.8	57.8	65.9	32.1
Clay	--	--	--	17.2	18	22.4	18.2	22.7	28.9	25.1	35.9	29.7	27.3	40.1	26.7	13.5	20.3
Fines	--	--	--	39.8	40.3	65.1	51.3	67.5	73.2	62.1	82.4	79.4	60.4	91.9	84.5	79.4	52.4
Metals (mg/kg)																	
Antimony	150	150	200	5 U	7 U	10 U	10 U	9 U	8 U	7 U	10 U	6 U	20 U	20 U	20 U	20 U	20 U
Arsenic	57	507.1	700	10	24	10	20	15	16	12	10	16	20 U	20	30	20 U	30
Cadmium	5.1	--	14	0.3	3	0.5 U	0.7	0.4 U	0.7	0.4	0.5 U	1.3	0.6 U	0.6 U	1.7	0.7	1.1
Chromium	--	267	--	51	56.8	62	64	50	66.2	64.9	71	66.3	30	81	86	54	49
Copper	390	--	1300	42.3	162	60.6	126	60.1	132	95.1	98.1	332	34.7	142	339	38.9	48.3
Lead	450	--	1200	21	92	66	96	23	80	43	482	198	17	106	1860	33	116
Mercury	0.41	1.5	2.3	0.11	0.86	0.23	0.76	0.26	0.67	0.45	0.33	11	0.22	0.66	2.12	0.1 U	0.3
Nickel	140	370	370	44	53	57	67	46	69	70	72	66	29	82	82	49	45
Selenium	--	3	--	0.2 U	0.3	0.2	0.2	0.7	0.4	0.3	0.2 U	0.3	1.1	0.3 U	0.3	0.8	1.3
Silver	6.1	6.1	8.4	0.3 U	0.4 U	0.8 U	0.8 U	0.6 U	0.8	0.4 U	0.8 U	0.4	0.9 U	1.0 U	1 U	0.9 U	1 U
Zinc	410	--	3800	98.9	276	158	230	74	266	176	153	427	66	227	609	140	129
LPAH (µg/kg)																	
Total LPAH	5200	--	29000	680	184	486	461	20 U	149	371	71	415	28	114	904	80	34
Naphthalene	2100	--	2400	24	20 U	57	130	20 U	56	42	32	120	28	31	130	20 U	32 U
Acenaphthylene	560	--	1300	33	20 U	24	28	20 U	20 U	20	20 U	26	20 U	20 U	61	20 U	32 U
Acenaphthene	500	--	2000	37	22	38	39	20 U	20 U	20 U	20 U	33	20 U	20 U	61	20 U	32 U
Fluorene	540	--	3600	60	20 U	37	37	20 U	20 U	27	20 U	40	20 U	20 U	72	20 U	32 U
Phenanthrene	1500	--	21000	440	130	250	180	20 U	71	250	39	160	20 U	62	460	80	32 U
Anthracene	960	--	13000	86	32	80	47	20 U	22	32	20 U	36	20 U	21	120	20 U	34
2-Methylnaphthalene	670	--	1900	20 U	20 U	20 U	28	20 U	20 U	20 U	20 U	38	20 U	20 U	50	20 U	32 U
HPAH (µg/kg)																	
Total HPAH	12000	--	69000	3498	1248	1969	1562	80	612	1794	332	1092	20 U	576	2988	977	155
Fluoranthene	1700	4600	30000	1000	260	560	330	42	140	490	93	270	20 U	140	660	160	41
Pyrene	2600	11980	16000	610	260	360	270	38	110	320	69	230	20 U	110	540	180	37
Benzo(a)anthracene	1300	--	5100	340	110	220	130	20 U	53	140	29	78	20 U	42	260	85	32 U
Chrysene	1400	--	21000	400	170	250	220	20 U	89	210	38	110	20 U	65	320	130	38
Benzofluoranthenes	--	--	--	570	190	330	300	20 U	120	360	72	199	20 U	46	500	191	39
Benzo(a)pyrene	1600	--	3600	250	120	150	160	20 U	53	150	31	110	20 U	53	350	89	32 U
Indeno(1,2,3-c,d)pyrene	600	--	4400	150	60	57	71	20 U	26	69	20 U	50	20 U	24	170	64	32 U
Dibenzo(a,h)anthracene	230	--	1900	68	20 U	20 U	22	20 U	20 U	20 U	20 U	20 U	20 U	20 U	48	21	32 U
Benzo(g,h,i)perylene	670	--	3200	110	78	42	59	20 U	21	55	20 U	45	20 U	21	140	57	32 U
Chlorinated Hydrocarbons (µg/kg)																	
1,3-Dichlorobenzene	170	--	--	1.3 U	2.3 U	1.7 U	1.3 U	3.2 U	1.8 U	4.5 U	1.3 U	1.7 U	6.2 U	1.7 U	3.0 U	2.7 U	2.7 U
1,4-Dichlorobenzene	110	--	120	1.3 U	2.3 U	1.7 U	1.3 U	3.2 U	1.8 U	4.5 U	1.3 U	1.7 U	6.2 U	1.7 U	3.0 U	2.7 U	2.7 U
1,2-Dichlorobenzene	35	--	110	1.3 U	2.3 U	1.7 U	1.3 U	3.2 U	1.8 U	4.5 U	1.3 U	1.7 U	6.2 U	1.7 U	3.0 U	2.7 U	2.7 U
1,2,4-Trichlorobenzene	31	--	64	6.7 U	12 U	8.7 U	6.7 U	16 U	8.8 U	20 U	6.6 U	8.5 U	20 U	8.7 U	15 U	14 U	14 U
Hexachlorobenzene	22	168	230	0.98 U	0.99 U	0.99 U	0.98 U	1.0 U	0.99 U	0.98 U	0.98 U	0.99 U	1.0 U	0.99 U	0.99 U	0.99 U	1.0 U

Table 4

Summary of Analytical Results for the DMMP Analyte List* and Comparison with the Evaluation Criteria

Location ID				A1-1	A1-2	A1-3	A1-4	A1-5	A1-6	A1-7	A1-8	A2A-1	A2B-1	A2B-2	A2B-3	FT-REF-1	FT-REF-2
Sample ID				A1-1-CS	A1-2CS	A1-3CS	A1-4CS	A1-5CS	A1-6CS	A1-7CS	A1-8CS	A2A-1CS	A2B-1-CS	A2B-2CS	A2B-3CS	FT-REF-1	FT-REF-2
Sample Date	DMMP Evaluation Criteria			9/28/2004	9/29/2004	9/29/2004	9/29/2004	9/29/2004	9/29/2004	9/29/2004	9/30/2004	9/30/2004	9/28/2004	9/30/2004	9/30/2004	10/14/2004	10/14/2004
Depth Interval	SL	BT	ML	0-7.5 ft	0-7.3 ft	0-5.8 ft	0-6.5 ft	0-5.5 ft	0-4.7 ft	0-6.4 ft	0-7.7 ft	0-3.6 ft	0-5.6 ft	0-4.9 ft	0-5.4 ft	0-25 cm	0-25 cm
Phthalates (µg/kg)																	
Dimethylphthalate	1400	--	--	26	20 U	20 U	20 U	20 U	29	20 U	29	21	20 U	20 U	26	20 U	32 U
Diethylphthalate	1200	--	--	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	32 U
Di-n-butylphthalate	5100	--	--	31	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	22	20 U	32 U
Butylbenzylphthalate	970	--	--	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	32 U
bis(2-Ethylhexyl)phthalate	8300	--	--	120 B	280	83 B	35 B	20 U	34 B	120 B	32 B	58 B	20 U	140 B	200 B	350	50
Di-n-octylphthalate	6200	--	--	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	38	20 U	32 U
Phenols (µg/kg)																	
Phenol	420	--	1200	24	20 U	24	34	52	73	29	45	24	20 U	20 U	35	20 U	32 U
2-Methylphenol	63	--	77	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	32 U
4-Methylphenol	670	--	3600	33	21	41	86	33	74	37	56	200	34	21	260	20 U	32 U
2,4-Dimethylphenol	29	--	210	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	32 U
Pentachlorophenol	400	504	690	100 U	99 U	99 U	98 U	99 U	99 U	98 U	99 U	98 U	99 U	98 U	99 U	99 U	160 U
Misc Extractables (µg/kg)																	
Benzyl alcohol	57	--	870	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	32 U
Benzoic acid	650	--	760	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	320 U
Dibenzofuran	540	--	1700	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	29	20 U	32 U
Hexachloroethane	1400	--	14000	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	32 U
Hexachlorobutadiene	29	--	270	0.98 U	0.99 U	0.99 U	0.98 U	1.0 U	0.99 U	0.98 U	0.98 U	0.99 U	1.0 U	0.99 U	0.99 U	0.99 U	1.0 U
n-Nitrosodiphenylamine	28	--	1300	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20 U	20	20 U	20 U	20 U	20 U	32 U
VOC (µg/kg)																	
Trichloroethene	160	--	1600	1.3 U	2.3 U	1.7 U	1.3 U	3.2 U	1.8 U	4.5 U	1.3 U	1.7 U	6.2 U	1.7 U	3.0 U	2.7 U	2.7 U
Tetrachloroethene	57	--	210	1.3 U	2.3 U	1.7 U	1.3 U	3.2 U	1.8 U	4.5 U	1.3 U	1.7 U	6.2 U	1.7 U	3.0 U	2.7 U	2.7 U
Ethylbenzene	10	--	50	1.3 U	2.3 U	1.7 U	1.3 U	3.2 U	1.8 U	4.5 U	1.3 U	1.7 U	6.2 U	1.7 U	3.0 U	2.7 U	2.7 U
Xylene (total)	40	--	160	1.3 U	2.3 U	1.7 U	1.3 U	3.2 U	1.8 U	4.5 U	1.3 U	2	6.2 U	1.7 U	3.0 U	2.7 U	2.7 U
Pesticides (µg/kg)																	
DDT (total)	6.9	50	69	0.14 U**	2.0 U	2.0 U	0.089 U**	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	3.4 U	2.0 U	3.7
Aldrin	10	--	--	0.98 U	0.99 U	0.99 U	0.98 U	1.0 U	0.99 U	0.98 U	0.98 U	0.99 U	1.0 U	0.99 U	0.99 U	0.99 U	1.0 U
alpha-Chlordane	10	--	--	0.98 U	0.99 U	0.99 U	0.98 U	1.0 U	0.99 U	0.98 U	0.98 U	0.99 U	1.0 U	0.99 U	0.99 U	0.87 J	1.0 U
Dieldrin	10	--	--	5.3 U	2.0 U	2.0 U	0.059 U**	2.0 U	4.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U	2.0 U
Heptachlor	10	--	--	0.98 U	0.99 U	0.99 U	0.98 U	1.0 U	0.99 U	0.98 U	0.98 U	0.99 U	1.0 U	0.99 U	0.99 U	0.99 U	1.0 U
alpha-BHC (mg/kg-OC)	--	10	--	0.98 U	0.99 U	0.99 U	0.98 U	1.0 U	0.99 U	0.98 U	0.98 U	0.99 U	1.0 U	0.99 U	0.99 U	0.99 U	1.0 U
gamma-BHC (Lindane)	10	--	--	0.98 U	0.99 U	0.99 U	0.98 U	1.0 U	0.99 U	0.98 U	0.98 U	0.99 U	1.0 U	0.99 U	0.99 U	0.99 U	1.0 U
PCBs (µg/kg)																	
Total PCBs	130	--	3100	**140 J**	**659**	**470**	**215**	20 U	95	20 U	30	119	20 U	22	40	--	--
Total PCBs (mg/kg-OC)	--	38	--	1.85	5.73	13.51	3.85	0.17	1.11	0.26	1.32	2.72	0.10	0.79	0.61	--	--

Notes:

0.86 (solid box) The result is higher than the DMMP Screening Level (SL) but lower than the Bioaccumulation Trigger (BT) or Maximum Level (ML).

2.12 (dashed box) The result is higher than the DMMP SL and BT but lower the ML.

11 (shaded) The result is higher than the DMMP SL, BT and ML.

U The analyte was not detected in sample.

B The analyte was found in the associated method blank at a level that is significant relative to the sample result.

J The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

* Results for TBT are included in Table 3.

** The MDL was used for reporting non-detects rather than the MRL because the MRL was greater than the criteria.

Table 5a. – DMMP EVALUATION GUIDELINES (BIOASSAYS)

<table>
<tr><th rowspan="2">Bioassay</th><th rowspan="2">Negative Control Performance Standard</th><th rowspan="2">Reference Sediment Performance Standard</th><th colspan="2">Dispersive Disposal Site Interpretation Guidelines</th><th colspan="2">Nondispersive Disposal Site Interpretation Guidelines</th></tr>
<tr><th>1-hit rule</th><th>2-hit rule</th><th>1-hit rule</th><th>2-hit rule</th></tr>
<tr><td rowspan="2">Amphipod</td><td rowspan="2">$M_C \leq 10\%$</td><td rowspan="2">$M_R - M_C \leq 20\%$</td><td colspan="2">$M_T - M_C > 20\%$
and
M_T vs M_R SD (p=.05)
and</td><td colspan="2">$M_T - M_C > 20\%$
and
M_T vs M_R SD (p=.05)
and</td></tr>
<tr><td>$M_T - M_R > 10\%$</td><td>NOCN</td><td>$M_T - M_R > 30\%$</td><td>NOCN</td></tr>
<tr><td rowspan="2">Sediment Larval</td><td rowspan="2">$N_C \div I \geq 0.70$</td><td rowspan="2">$N_R \div N_C \geq 0.65$</td><td colspan="2">$N_T \div N_C < 0.80$
and
N_T/N_C vs N_R/N_C SD (p=.10)
and</td><td colspan="2">$N_T \div N_C < 0.80$
and
N_T/N_C vs N_R/N_C SD (p=.10)
and</td></tr>
<tr><td>$N_R/N_C - N_T/N_C > 0.15$</td><td>NOCN</td><td>$N_R/N_C - N_T/N_C > 0.30$</td><td>NOCN</td></tr>
<tr><td rowspan="2">Neanthes growth</td><td rowspan="2">$M_C \leq 10\%$
MIG $\geq$ 0.38 mg/ind/day</td><td rowspan="2">$MIG_R \div MIG_C \geq 0.80$</td><td colspan="2">$MIG_T \div MIG_C < 0.80$
and
MIG_T vs MIG_R SD (p=.05)
and</td><td colspan="2">$MIG_T \div MIG_C < 0.80$
and
MIG_T vs MIG_R SD (p=.05)
and</td></tr>
<tr><td>$MIG_T/MIG_R < 0.70$</td><td>NOCN</td><td>$MIG_T/MIG_R < 0.50$</td><td>$MIG_T/MIG_R < 0.70$</td></tr>
</table>

M = mortality, N = normals, I = initial count, MIG = mean individual growth rate,
SD = statistically different, NOCN = no other conditions necessary, N/A = not applicable
Subscripts: R = reference sediment, C = negative control, T = test sediment

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Table 5b
Comparison of Bioassay Test Performance for Acclimated and Unacclimated Sediments

Treatment	Amphipod (*E. estuarius*)			Polychaete Chronic (*N. arenaceodentata*)					Bivalve Larval (*M. galloprovincialis*)		
	Mean Percentage Mortality		Statistical Difference	Mean Percentage Survival		Mean Individual Growth Rate (mg/ind/day)		Statistical Difference	Mean Percentage Combined Normal		Statistical Difference
FT-Ref 2	18.0	7.6		100.0	0.0	0.77	0.1		25.5	3.4	
FT-Ref 2 UA	7.0	2.7	Yes	96.0	8.9	0.56	0.1	Yes	0.0	0.0	Yes
A1-2CS	16.0	8.2		96.0	8.9	0.55	0.1		7.8	6.6	
A1-2CS UA	16.0	14.7	No	100.0	0.0	0.55	0.2	No	0.3	0.6	No
A1-4CS	21.0	17.1		100.0	0.0	0.86	0.1		57.9	11.8	
A1-4 CS UA	16.0	10.2	No	100.0	0.0	0.64	0.2	No	0.8	1.3	Yes
A1-8CS	19.0	16.4		100.0	0.0	0.90	0.1		75.3	19.8	
A1-8CS UA	20.0	3.5	No	100.0	0.0	0.71	0.1	Yes	13.2	6.4	Yes

UA–Unacclimated

Table 6
10-Day Acute Amphipod Mortality Test Performance Summary—*Eohaustorius sp.*

Treatment	Percentage Mortality	M_T-M_C > 20%?	Statistically Less than FT-Ref 2 Reference	M_T-M_R > 30%?	Fails 2- Hit Rule?	Fails 1-Hit Rule?
Control	5.0 ± 3.5	--	--	--	--	--
FT-Ref 2	18.0 ± 7.6	No (13%)	No*	--	No	No
A1-8CS	19.0 ± 16.4	No (14%)	No	No (1%)	No	No
A1-1CS	7.0 ± 7.6	No (2%)	No	No (0%**)	No	No
A1-2CS	16.0 ± 8.2	No (11%)	No	No (0%)	No	No
A1-3CS	19.0 ± 9.6	No (14%)	No	No (1%)	No	No
A1-4CS	21.0 ± 17.1	No (16%)	No	No (3%)	No	No
A1-6CS	16.0 ± 11.4	No (11%)	No	No (0%)	No	No
A1-7CS	10.0 ± 7.9	No (5%)	No	No (0%)	No	No

* Compared to A1-8

** Negative values corrected to 0%

Table 7
48-Hour Acute Larval Mortality/Abnormality Test Performance Summary – *Mytilus sp.*

Treatment	Mean Percentage Combined Normal (N)	$N_T/N_C < 0.80$?	Statistically Less than A1-8 Reference?	$N_R/N_C - N_T/N_C > 0.30$?	Fails 2-Hit Rule?	Fails 1-Hit Rule?
Control	85.6 ± 8.2	--	--	--	--	--
FT-Ref 2	25.5 ± 3.4	Yes* (0.30)	Yes*	Yes* (0.58)	Yes*	Yes*
A1-8CS	75.3 ± 19.8	No** (0.88)	No**	--	No	No
A1-1CS	24.5 ± 10.8	Yes (0.34)	Yes	Yes (0.59)	Yes	Yes
A1-2CS	7.8 ± 6.6	Yes (0.10)	Yes	Yes (0.79)	Yes	Yes
A1-3CS	57.4 ± 11.4	Yes (0.76)	No	No (0.21)	No	No
A1-4CS	57.9 ± 7.0	Yes (0.77)	No	No (0.20)	No	No
A1-6CS	52.1 ± 10.1	Yes (0.69)	Yes	No (0.27)	Yes	No
A1-7CS	49.1 ± 11.9	Yes (0.65)	Yes	No (0.30)	Yes	No

* Compared to the sample A1-8
** Compared to seawater control

Table 8
20-Day Juvenile Polychaete Test Performance Summary – *Neanthes sp.*

Treatment	Mortality (%)	Mean Individual Growth Rate (mg/ind/day)	$MIG_T/MIG_C < 0.80$?	Statistically Less than FT-Ref 2 Reference?	MIG_T/MIG_R	$MIG_T/MIG_R < 0.70$?	$MIG_T/MIG_R < 0.50$?	Fails 2-Hit Rule?	Fails 1-Hit Rule?
Control	0	0.97 ± 0.1	--	--	--	--	--	--	--
FT-Ref 2	0	0.77 ± 0.1	Yes (0.79)*	Yes**	--	--	--	--	--
A1-1CS	0	0.65 ± 0.1	Yes (0.67)	Yes	0.85	No	No	No	No
A1-2CS	4	0.55 ± 0.1	Yes (0.56)	Yes	0.71	No	No	No	No
A1-3CS	0	0.95 ± 0.3	No (0.97)	No	1.23	No	No	No	No
A1-4CS	0	0.86 ± 0.1	No (0.88)	No	1.12	No	No	No	No
A1-6CS	8	0.82 ± 0.2	No (0.84)	No	1.07	No	No	No	No
A1-7CS	0	0.72 ± 0.1	Yes (0.74)	No	0.93	No	No	No	No
A1-8CS	0	0.90 ± 0.1	No (0.93)	No	1.18	No	No	No	No

* Fails reference criteria for MIG
** Compared to control sediment

Table 9
Summary of Chemical and Bioassay Testing Results
and Proposed Suitability Determinations

DMMU	Volume (cy)	Screening Level Exceedance?	Amphipod Bioassay		Larval Bioassay		Juvenile Polychaete Bioassay		Proposed Suitable for Open Water Disposal?
			2-Hit Rule Failure?	1-Hit Rule Failure?	2-Hit Rule Failure?	1-Hit Rule Failure?	2-Hit Rule Failure?	1-Hit Rule Failure?	
A1-1	4247	Yes	No	No	Yes	Yes	No	No	No
A1-2	4312	Yes	No	No	Yes	Yes	No	No	No
A1-3	4013	Yes	No	No	No	No	No	No	Yes
A1-4	3978	Yes	No	No	No	No	No	No	Yes
A1-5	4103	No	NA	NA	NA	NA	NA	NA	Yes
A1-6	4003	Yes	No	No	No	No	No	No	Yes
A1-7	3912	Yes	No	No	Yes	No	No	No	Yes
A1-8	3978	Yes	No	No	Yes	No	No	No	Yes

NA – not applicable

Table 10. Sediment Larval Results Interpretation using Best Profession Judgment: 80% Absolute Criterion for comparison*

DMMU	Mean % Combined Normal Larvae	**N_T/N_C < 0.80?** N_T > 0.80 = NH N_T < 0.80 = reference/criterion comparison	Criterion Comparison N_T – 80%[1] = 2H < 30% 1H >30%	DMMP interpretation
Control (N_C):	85.6	--	--	--
Test Sediment (N_T): 8CS	75.3	0.88 (no)	4.7	NH
7CS[2]	49.1	0.573 (yes)	30.9	1H = 2H (BPJ)
6CS	52.1	0.609 (yes)	27.9	2H
4CS	57.9	0.678 (yes)	22.1	2H
3CS	57.4	0.670 (yes)	22.6	2H
2CS	**7.8**	**0.091 (yes)**	**65.2**	**1H**
1CS	**24.5**	**0.286 (yes)**	**55.5**	**1H**

* Conservative interpretation using 80% absolute (100 - 20 = 80) as criterion for alternative Test Sediment Interpretation

Reference Sediment Performance: $N_R/N_C \geq 0.65$ (N_R = 85.6 x 0.65 = **≥55.6** (minium acceptable reference). 8CS as surrogate reference: 75.3/85.6 = 0.88 (meets reference performance requirements, i.e. > 0.65)

NH = no hit response

[1] Test sediment (normal larvae). N_T/N_C < 0.20 (e.g., >0.80 normal) = suitable UCOWD without comparison to reference sediment. N_T/N_C > 0.20 (e.g., < 0.80 normal), requires comparison with reference.
[2] Freshwater reference sediment is unlikely to have normal survival <85% of negative control: 85% - 57.3% < 30%. Therefore based on the weight of evidence and BPJ, DMMU-7CS is a 2H response for the suitability determination.

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September 27, 2004

David R. Kendall, Ph.D.
Chief, Dredged Material Management Office
Seattle District, U.S. Army Corps of Engineers
P.O. Box 3755
Seattle, WA 98124-3755

Re: Response to DMMP Agency Comments on the Port of Seattle Fishermen's Terminal Sediment Characterization Sampling and Analysis Plan

Dear Dr. Kendall:

For expediency in referencing comments, I am including the pdf version of the DMMP agencies' comment/approval letter with this letter addressing the specific comments. As such, the text of the comments is not repeated in this response letter.

Response to Comment No. 1

The Port understands that the DMMP agencies will conduct a reason-to-believe review prior to allowing a one-year extension to the usual two-year recency period for "high" ranked sediments.

Response to Comment No. 2

For DMMUs A1-3 and A1-5, surface elevations in the vicinity of the outfalls are approximately +1 ft NGVD 29. The project depth for area A1 is –2 ft NGVD 29 plus one foot allowable overdepth, which would yield core lengths of approximately 4 feet. The locations selected in DMMUs A1-3 and A1-5 were chosen to penetrate thicker portions of the dredge prism in order to characterize more of the volume. In DMMU A1-1, Station 1 is near an outfall. The location of Station 2 was chosen to yield better spatial representation. The surface elevation of the present location of Station 2 (+3 ft NGVD29) is only one foot less than a feasible location nearer the outfall on the West Wall. Station 2 could conceivably be moved, but some spatial representativeness would be reduced.

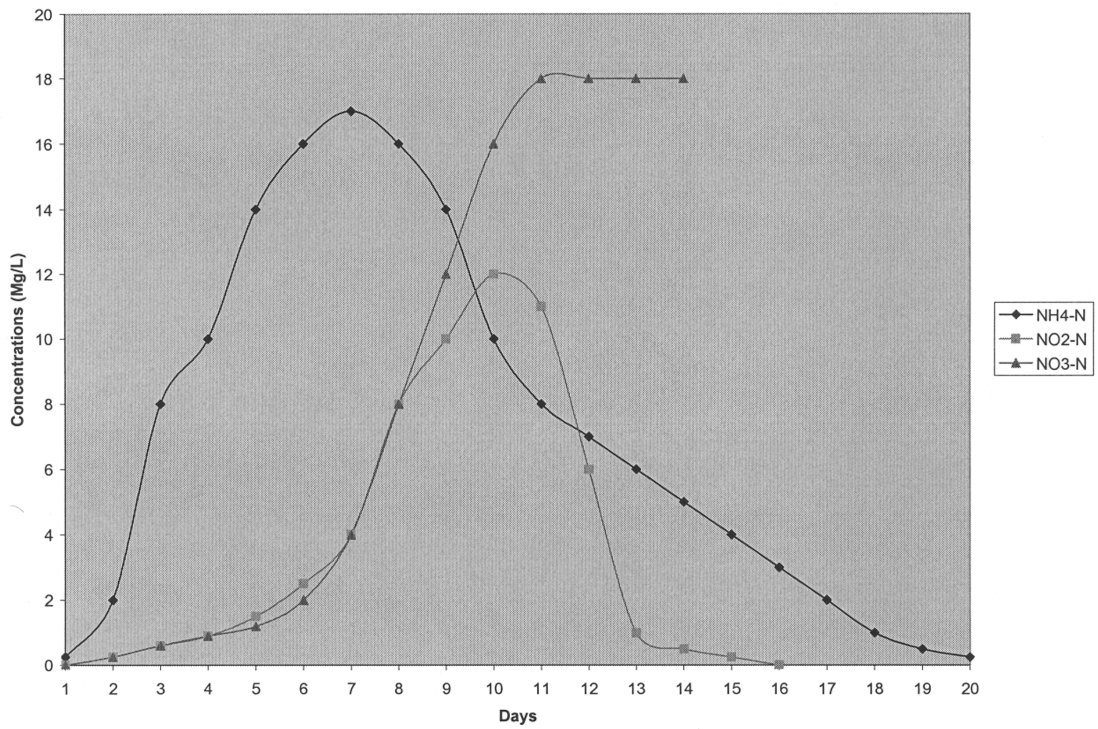
Response to Comment No. 3

Bioassays are conducted to assess potential toxicity at the disposal site. The proposed disposal site is the Elliott Bay Open Water Disposal Site, which is a marine environment. Test sediments are from a freshwater environment. There is a potential for toxicity stemming from conducting marine bioassays using freshwater sediment samples that is not due to inherent toxicity due to contamination. The Port proposes the inclusion of a freshwater reference sample to provide additional information about the potential sources if toxicity is determined in the bioassays.

Following are additional information and a proposed protocol provided by MEC-Weston Solutions, Inc., who will be performing the toxicity testing:

Assessment of Bioassay Effects from Freshwater Sediments

Bioassay assessment needs to distinguish between the affects of Chemicals of Potential Ecological Concern (COPECs) and other factors that provide unacceptable habitat for test organisms (Word et al., in press). There are a number of potential confounding factors associated with removing sediment from freshwater environments and placing it into marine waters. The most obvious is the effect that low salinity water would have on marine organisms. While estuarine organisms can tolerate the changes in salinity, this relatively simple adjustment to testing does not address some of the other factors. One of the more significant factors is that freshwater sediments are acclimated to those conditions and the microbial communities that control nitrification processes must either adjust or change to accommodate the new marine environmental conditions (Bower and Turner, 1981). During that adjustment period there is disruption in the health of these microbial communities and their processing of nitrogen becomes less efficient with a resulting increase in ammonia concentrations. The success and extent of the adjustment can be followed by examining the nitrification process in the overlying and interstitial waters of the acclimating sediment. The normal process begins with relatively low concentrations of ammonia increasing to much higher values during the initial periods with ammonia concentrations reducing as the microbial community becomes acclimated to the new conditions. This process continues with nitrite and ends with nitrates being regenerated into nitrogen. A diagram of this generalized process is indicated in the following figure.



Because ammonia is acutely toxic it is generally not feasible to determine the role of COPECs. There are multiple ways that have been established in the PSDDA process to account for ammonia effects when placing marine sediment into marine disposal sites. These processes include reference toxicant exposures water spiked with ammonia to account for observed effects in tests or performing static renewal of overlying water to reduce the concentrations of ammonia released into the overlying water. However, it is anticipated ammonia concentrations will be much higher when freshwater sediment is placed into marine conditions than for marine sediments and that these two methods will not be sufficient to address these changes.

The suggested protocol modifications for these conditions (freshwater sediment placed into marine disposal sites) are to allow the marine microbial community to establish itself prior to testing. The acclimation period is determined based on the change in concentrations of ammonia in overlying water. The overlying water concentrations are anticipated to increase over a period of 10 to 20 days and then rapidly decrease in concentration. When the overlying water concentrations decrease to no observable effects levels (NOEC), the pore water will be sampled and measured for ammonia at intervals to ensure that the interstitial water concentrations are below effects levels. We anticipate that we will immediately set up all test sediments (including the fresh water reference treatment) to accommodate this acclimation period. Only those sediment treatments that have sediment concentrations exceeding guidance values and are selected for testing will be used in toxicity tests. Acclimated sediments will be tested with amphipod and polychaete tests concurrent to test sediments without acclimation.

At the conclusion of the parallel sediment tests, survival and growth of the acclimated and "non-acclimated" treatments will be directly compared, as well as compared with reference treatments.

To accommodate this strategy, seven additional replicate test containers will be acclimated for each treatment. These will be sacrificial containers to establish the pore water concentrations of ammonia at the beginning of the acclimation process, at the point in time when the overlying water ammonia concentrations reach the NOEC, at unspecified time intervals after the overlying water ammonia concentration is acceptable, at the time of test organism addition and at the end of the experiment. Three additional replicates will also be added to the test array for the non-acclimated test containers for evaluation at the beginning, middle and the end of the non-acclimated treatments.

Bower, C.E. and D.T. Turner. 1981. Accelerated nitrification in new seawater cultures systems: effectiveness of commercial additives and seed media from established systems. Aquaculture 24: 1-6.

Word, J. Q., W.W. Gardiner and D.W Moore, in Press. Chapter 16. *Influence of confounding factors on SQGs and their application to estuarine and marine sediment evaluations* SETAC Pellston Workshop on Sediment SQGs. SETAC Pellston Publication.

Dr. Jack Word of MEC-Weston Solutions, Inc. will confer with the DMMP agencies and Port regarding an approved approach for toxicity testing of sediment samples (if necessary) from Fishermen's Terminal. Toxicity testing will not commence until all parties are in agreement.

Response to Comment No. 4

The bioassay laboratory has been notified that *Mytilus galloprovincialis* is the preferred species for the sediment larval bioassay.

Response to Comment No. 5

The bioassay laboratory has been notified that *Neanthes arenaceodentata* is the preferred species for the juvenile polychaete bioassay.

Response to Comment No. 6

The Port's contractor will be directed to visually inspect sediment cores and describe any marked visual or odor transitions. If suspicious fine-grained sediment layers are identified, the contractor will collect subsamples and archive them.

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November 22, 2004

David R. Kendall, Ph.D.
Chief, Dredged Material Management Office
Seattle District, U.S. Army Corps of Engineers
P.O. Box 3755
Seattle, WA 98124-3755

Re: Port of Seattle Fishermen's Terminal – Docks 5-10 Project
TBT Concentrations in Porewater from Unacclimated and Corresponding Acclimated Sediment Samples

Dear Dr. Kendall:

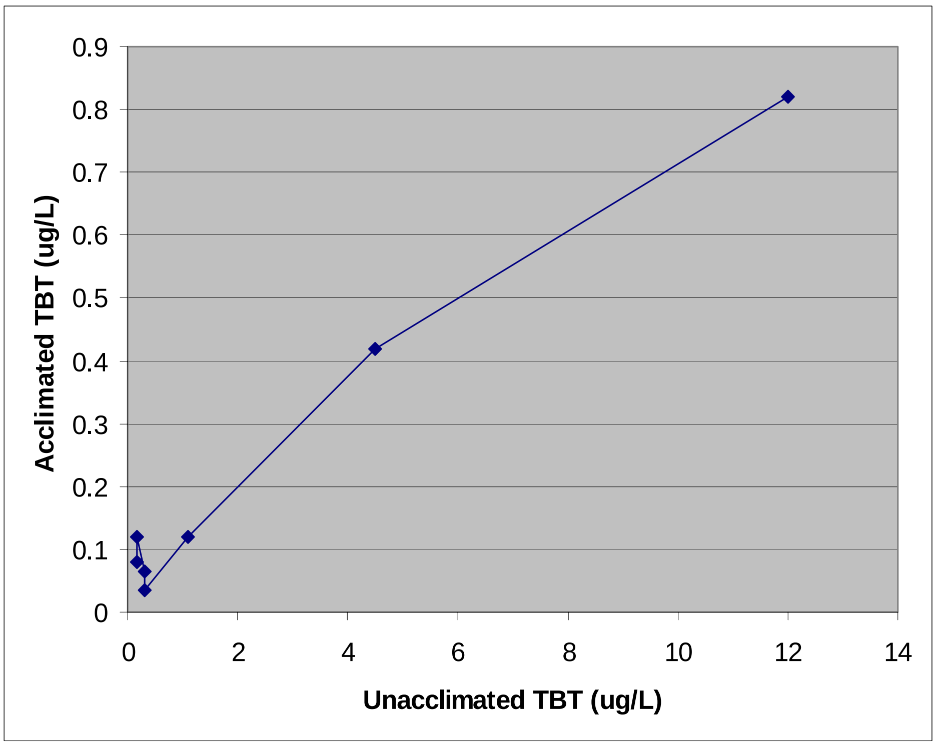
The Port of Seattle (Port) has received analytical results for porewater TBT concentrations in Fishermen's Terminal samples that were acclimated to marine conditions. Previously, porewater TBT concentrations in seven of twelve freshwater (unacclimated) sediment samples from Fishermen's Terminal exceeded the bioaccumulation trigger (BT) concentration of 0.15 μg/L TBT as ion. A discussion on October 21, 2004 among Tom Gries of Ecology, Jack Word and Bill Gardiner of MEC-Weston Solutions, Dennis Hanzlick of Anchor Environmental, and you led to approval of using porewater TBT concentrations in acclimated sediments to determine whether bioaccumulation testing would be required. As discussed, this approach was to be applied to those sediments whose initial analysis as freshwater sediments showed porewater TBT concentrations exceeded the BT.

Tabulated and plotted below are the analytical results for porewater TBT concentrations in unacclimated and acclimated sediment samples from Fishermen's Terminal. By a separate e-mail message, I will transmit to you pdf files of both laboratory reports for the porewater TBT analyses. Only samples whose porewater concentrations exceeded the BT in the unacclimated sediments were also tested in corresponding acclimated sediments. Porewater TBT concentrations in the five acclimated samples from Area 1 (A1) are less than the BT. Concentrations in the two acclimated samples from Area 2 (A2) are markedly less than concentrations in the corresponding unacclimated samples, but still exceed the BT. While not strictly true for all samples, the general trend is that those with higher concentrations in the unacclimated sediments tended to have higher concentrations in the acclimated sediments, which gives us confidence that the acclimation and testing processes are valid.

Attachment 2

DMMU ID	TBT ion (µg/L)	
	Unacclimated	Acclimated
A1-1	0.16	0.079
A1-2	0.18	0.12
A1-6	0.31	0.065
A1-7	0.31	0.036
A1-8	1.1	0.12
A2B-2	4.5	0.42[a]
A2A-1	12	0.82

[a] - average of 0.24 (sample) and 0.59 (lab duplicate)



In view of the agreement to use porewater TBT concentrations in acclimated sediments to determine whether bioaccumulation testing would be required, and taking into account that the TBT concentrations in the five acclimated sediment samples from Area 1 are less than the BT, the Port requests concurrence from the DMMP agencies that bioaccumulation testing will not be required for DMMUs A1-1, A1-2, A1-6, A1-7, AND A1-8. As previously discussed with you, the Port has decided not to dredge Area 2 due to changing priorities, and therefore concludes that no further testing is required for any Area 2 DMMUs.

I am at your disposal (206-903-3317) to answer questions or provide additional information. For expediency, I recommend communicating the DMMP agencies' decision/concurrence directly to Ms. Leslie Sacha (206-728-3127 or sacha.L@portseattle.org) at the Port of Seattle.

Sincerely,

Dennis Hanzlick, Ph.D.
Anchor Environmental, L.L.C.

cc: Leslie Sacha, Port of Seattle
Fred Chou, Port of Seattle
Tom Gries, Department of Ecology
Jack Word, MEC-Weston Solutions
Bill Gardiner, MEC-Weston Solutions
Tom Wang, Anchor Environmental
Bruce McDonald, Anchor Environmental
040003-01 BG 1 Project Files

DEPARTMENT OF THE ARMY
SEATTLE DISTRICT, CORPS OF ENGINEERS
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REPLY TO
ATTENTION OF

December 6, 2004

Operations Division/Technical Support Branch
Dredged Material Management Office

Dennis Hanzlick, Ph.D.
Anchor Environmental, L.L.C.
1423 Third Avenue, Suite 300
Seattle, Washington 98101
Seattle, WA 98104

Re: Port of Seattle – Fishermen's Terminal
Project: DMMP Determination on the TBT porewater SL exceedances for Acclimated versus Unacclimated Results

Dear Dr. Hanzlick:

This letter responds to your November 22, 2004 letter report summarizing the results of the TBT pore water concentrations from unacclimated and corresponding acclimated sediment samples. Based on the meeting on October 21, 2004, in which Tom Gries and I participated, we agreed that the results of the acclimated TBT porewater sediments, could probably serve as the determining factor for SL exceedances and subsequent bioaccumulation testing requirements.

The results of the acclimated DMMU samples showed a significant drop in porewater TBT concentrations compared with the unacclimated samples. Of the seven samples, only the two collected within Area 2 (DMMU ID: A2B-2 and A2A-1) demonstrated porewater TBT concentrations still exceeding the DMMP SL, while the remaining five DMMUs from within Area 1 had acclimated TBT porewater concentrations below the DMMP SL of 0.15 ug/L.

The DMMP agencies discussed the acclimation/unacclimation results and concur that the **acclimated** TBT porewater concentrations are the appropriate comparison to the DMMP screening level of 0.15 ug/L. Therefore, the five DMMU's within Area 1 (A1-1, A1-2, A1-6, A1-7, and A1-8) are all below the TBT porewater screening level, based on the acclimated testing results. It is also our understanding that that the proposed dredged material within Area 2 is no longer being considered for dredging and disposal at this time due to funding limitations (Leslie Sacha, personal communication), and therefore no further testing of the material within Area 2 is planned at this time. Without the required bioaccumulation testing, all the material within Area 2 is considered unsuitable for unconfined open-water disposal.

Attachment 3

Please call me (206-764-3768) if you have any questions about our consensus determination on the acclimated versus unacclimated TBT porewater test results.

Sincerely,

David R. Kendall, Ph.D.
Chief, Dredged Material Management Office

Enclosures
Copies Furnished:

Peter Leon, DNR
John Malek, EPA
Tom Gries, Ecology
Cinde Donoghue, Ecology
Jessica Winkler, Corps Regulatory Branch
DMMO file

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January 18, 2005

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Re: Port of Seattle Fishermen's Terminal – Docks 5-10 Project: Use of Sample A1-8CS as Reference Sample for Larval Bioassays

Dear Dr. Kendall:

The Port of Seattle (Port) has received results for amphipod, larval, and juvenile polychaete bioassays for samples associated with sediment characterization at Fishermen's Terminal. Results were for a negative control, one reference sample, and seven test samples. The purpose of this letter is to notify the DMMP agencies of the Port's plan to use Fishermen's Terminal Sample A1-8CS as the reference sample for evaluating larval bioassays and to briefly outline the rationale for doing so. In addition to this preferred approach using Sample A1-8CS, we present an alternative that involves using the allowable reference response relative to control. The sediment characterization report will reflect the preferred approach, and the Port and its consulting team felt that it was important to inform the DMMP agencies ahead of time.

MEC-Weston Solutions, Inc. (MEC) performed the bioassays and evaluated the results in coordination with Anchor Environmental, L.L.C. (Anchor). The data report that presents results of chemical and biological analyses is currently in preparation. In evaluating the results of the bioassays, we found that the standard approach of comparisons of performance among control, reference, and test sediments applied to the amphipod and juvenile polychaete bioassays, but we encountered a problem when attempting to make comparisons against reference performance for the larval bioassay. Although the seawater controls met test criteria, with a percentage normal survivorship (as defined in Table 6-1 of the PSDDA User's Manual) of 85.6%, the percentage normal survivorship for the reference treatment was 25.5 percent. The ratio of reference to control is 0.30, which is well below the performance standard of 0.65. The table below lists the normal survivorship for all treatments for the larval bioassay.

Anchor pursued efforts to locate an acceptable freshwater reference site. Anchor requested information from King County regarding potential freshwater locations that could be used as sources of reference sediment for bioassays. Anchor received two locations: one was in Lake Sammamish and the other was in the northeastern part of Lake Washington where Sammamish Slough connects. Data for the location in Lake Sammamish indicated toxicity in previous testing, so this location was excluded from consideration. Anchor collected one sample near the

Attachment 4

mouth of Sammamish Slough in northeast Lake Washington, and because of the uncertainty of a single sample being acceptable as a reference, while mobilized, Anchor collected a second sample from a location east of St. Andrew's State Park in the northeast portion of Lake Washington. The second sample had a closer grain size match to Fishermen's Terminal samples. Given the time and expense required to collect and test several samples in hopes of selecting an empirically-derived reference sediment sample, we proceeded with bioassays with the two potential reference samples that had been collected. The sample collected near the mouth of Sammamish Slough was later eliminated from testing because of extremely low pH (<4.0) in the overlying water of this test sediment and the formation of a thick layer of iron precipitate on the sediment surface.

In response to the poorly-performing reference sediment sample, the Port proposes two alternative approaches for evaluating the suitability of the test sediments: Preferred - use the Fishermen's Terminal Sample A1-8CS, or the Alternate - use the allowable reference response as stated in Table 6.1 of PSDDA User's Manual.

> *Preferred Approach:* Sample A1-8CS is a freshwater sediment tested in marine conditions and as such can account for the physical and chemical changes that occur in acclimating sediments. Sample A1-8CS also met the performance criteria for a reference sediment relative to control performance. Furthermore, the sediment chemistry from this treatment indicates non-detects or detections that are well below screening level concentrations for most analytes, with the exception of lead, which slightly exceeded the screening level criterion.

> *Alternate Approach:* The second approach would use the allowable response for reference sediment, which is 80% normal development, relative to the observed control response. Relative to the control response observed for this program, that value would be 65.5%.

We should note that neither a marine reference nor control seawater would be appropriate for evaluating these test treatments. Marine reference sediment and control seawater cannot account for the many physical and chemical changes that occur during the transformation of freshwater sediment to marine conditions. Furthermore, control seawater cannot account for the interactions between the test organisms and the suspended and bedded sediment both during exposure and at test termination.

Pursuing these alternative approaches assists the Port in adhering to an aggressive time schedule for permitting and construction planning. The Port, Anchor, and MEC will respond to DMMP agency questions and concerns that might arise during their review of the draft report.

Table 1. Draft Test Results for 48-h Acclimated Test with Larval *M. galloprovincialis*

Treatment	Mean Percent Normal Survivorship	SD	Mean Percent Survival	SD	Mean Percent Normal	SD
Control	85.6	8.2	96.9	5.2	95.9	3.6
Reference 2	25.5	3.4	50.0	5.4	57.2	6.4
A1-1CS	24.5	10.8	35.5	13.5	77.1	9.2
A1-2CS	7.8	6.6	22.8	6.1	33.5	25.6
A1-3CS	57.4	11.4	65.9	12.4	97.5	1.8
A1-4CS	57.9	11.8	68.8	2.5	94.3	2.5
A1-6CS	52.1	10.1	62.1	7.9	94.7	1.0
A1-7CS	49.1	11.3	56.1	12.8	97.4	3.2
A1-8CS	75.3	19.8	87.6	16.6	97.5	2.5

On behalf of the Port, I express appreciation for the cooperation and open-mindedness of the DMMP agencies in dealing with the complexities of this sediment characterization project. I want to emphasize that this letter is meant to provide information – the Port will continue to work in concert with the DMMP agencies to the conclusion of this sediment characterization process.

Sincerely,

Dennis Hanzlick

Dennis Hanzlick, Ph.D.
Anchor Environmental, L.L.C.

cc: Fred Chou, Port of Seattle
Doug Hotchkiss, Port of Seattle
Tom Gries, Department of Ecology
Jack Word, MEC-Weston Solutions
Bill Gardiner, MEC-Weston Solutions
Tom Wang, Anchor Environmental
Bruce McDonald, Anchor Environmental
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